

SHELLFISH AND BENTHOS COMMITTEE

by J.E. Stewart

1975

MOLLUSCA AND BENTHOS

Belgium

(Reporting on Crustacea Only)

Canada

(J.E. Stewart)

Crassostrea virginica

The oyster population distribution, density, structure and standing crop were studied in a number of important oyster producing areas of the Maritimes. Recruitment has been regular over the past few years with all year classes being represented with the population.

The combined landings from a spring relaying fishery conducted in the Dunk and Wilmot Rivers traditionally makes Summerside Harbour the single most important oyster producing area of Prince Edward Island. The populations exhibited a good resilience to the fairly heavy fishing pressure exerted on them in recent years and are currently in a healthy condition.

The five year oyster (Crassostrea virginica) spatfall inventory program, to determine commercially reliable oyster spat collection sites throughout Prince Edward Island and New Brunswick, was completed in 1975. In both provinces almost all monitoring stations recorded commercially significant settlement. In Prince Edward Island and southern New Brunswick, the mean number of spat collected per station was well above the results from other years. The mean set for northern New Brunswick, while not the highest, was considerably above the five-year mean. A good set was also recorded for other areas not covered by this program.

A managerial scheme for oyster spat-collection preserves was developed and successfully implemented in areas of high commercial utilization such as Gillis Cove and Portage Inlet in Cape Breton. This scheme is designed to control entry and maintain the commercial productivity of these valuable spat-collecting areas.

An expanded pilot depuration operation for soft-shelled clams (Mya arenaria) was conducted in the Annapolis Basin area of Nova Scotia. Engineering improvements, primarily in the pumping equipment, brought reliability to the system and allowed proper control of the experiments.

Nutritional studies on oysters showed that they had an essential requirement for omega-3 fatty acids (linolenic series). Radio-active tracer studies showed that oysters do not synthesize sterols from acetate and mevalonate, thus there may be a dietary requirement for sterols for the oysters.

Studies on Malpeque disease of oysters were continued in 1975. This disease which has caused serious damage in the past and constituted a serious obstacle to oyster farming may be caused by a Labyrinthula sp. The protozoan has been isolated and cultured; transmission studies and in vivo and in vitro experiments are being conducted to secure information for developing measures to cope with the problem.

#### Ostrea edulis

Transplanted oysters in St. Mary's Bay and Conception Bay, Nfld., suffered over-winter mortalities (1974-1975) of 9.0 and 5.8 percent; 13.6 and 16.5 percent, respectively, of the remaining oysters died during May to November. Shell growth was very slight; <.2cm for St. Mary's Bay and <.3cm for Conception Bay. The transplant experiment was terminated in November, 1975.

#### Placopecten magellanicus

Systematic density surveys were conducted in selected areas. The biological feasibility of collecting scallop spat from nature in numbers large enough to allow culture of the species has been demonstrated and settlement and survival of spat in enclosed polyethylene tubes was documented. Growth of juveniles in suspended culture is being monitored.

Steady progress has been made toward further implementation of Georges Bank size regulations, based on advice formulated in 1972. A more elaborate seasonal closure concept for the Georges Bank fishery early this year was not accepted by the industry, largely because present high landings have blunted the urgency of further conservation measures; however, a closure of the fishery during the winter and spring months would protect the incoming year class from exploitation at the time when they first become available to the gear and before the period of fastest seasonal growth has begun.

A less rosy picture applies to the Bay of Fundy and Gulf scallop fisheries: assessments of both of these fisheries have been made, indicating that low and declining landings result from fleet sizes more than twice those needed to provide close to optimal yields.

#### Chlamys islandicus

Studies on distribution and population dynamics in the north-east Gulf of St. Lawrence continued. A dredge survey was conducted and data were collected on size distributions, meat weights and maturities. About 1,000 animals were tagged in an experiment to validate aging techniques.

At the invitation of the Institut Scientifique et Technique des Pêches Maritimes at St. Pierre, staff participated in a transplant of the Iceland Scallop. Ten metric tons comprising about 130,000 scallops were caught off the NW slope of St. Pierre Bank and released at a new location about 8 km east of the Isthmus of Langlade. Preliminary estimates indicate a total initial mortality of about 30%.

#### Illex illecebrosus

Landings in the Newfoundland inshore fishery increased to 3,000 tons in 1975 following a complete failure of the fishery in 1974. Biological characteristics of inshore populations were monitored. Staff participated in

two squid research cruises undertaken by the Institut Scientifique et Technique des Pêches Maritimes on the continental shelf from Nova Scotia to New England.

#### Other cephalopods

Work continued on the systematics and zoogeography of the genus Rossia, a group of small benthic species. Detailed morphometrics and biological analyses were made on about 800 specimens of Bathypolypus arcticus, the most common octopus of the Northwest Atlantic.

#### Chondrus crispus

Approximately 45,000,000 wet kg of Chondrus crispus is harvested annually off the east coast of Canada. Recently, a program was initiated to acquire the biological information deemed necessary to permit management of this natural resource.

The location of commercially important beds in both western Prince Edward Island and southwestern Nova Scotia was determined as was the mean number of harvesters per bed. The harvesting techniques were observed in each area. Large metal rakes are towed behind boats 7.5 m to 13.5 m in length in western Prince Edward Island whereas handrakes are employed in southwestern Nova Scotia. Studies were initiated to determine the ecological impact of these two harvesting techniques. It appears that dragraking is more deleterious in that a greater number of immature Chondrus plants are removed as are more Chondrus holdfasts and that lobsters are taken at the rate of 2.5 per hour. Handrakers rarely catch lobsters.

#### Shellfish Growth, Productivity

Studies concerning the use of mussels and oysters as productivity indicators are continuing. Previous work with Mytilus edulis demonstrated that growth in young animals was a reasonably good predictor for growth performance in subsequent months. Differences observed in mussel growth between St. Margaret's Bay and Bedford Basin were due to environmental differences since a common stock of animals was used for culture. There was a suggestion that relative growth in various seasons and environments could be genetically determined.

Observations with Mytilus left some questions unanswered, one of which was that concerning high mortalities in the large size classes in Bedford Basin. An additional experiment will re-examine this phenomenon and a parallel trial will be run using oysters as a test of the relative sensitivity of the two bivalves to the "pollutant". The experiment may be important in demonstrating the use of mussels and perhaps oysters as in situ assay or indicator species.

Clam productivity studies, begun two years ago in St. Margaret's Bay, will continue at least for two more years. Both the soft-shell clam (Mya arenaria) and the razor clam (Ensis directus) which are well distributed throughout the Maritimes are being examined. The support system which has been devised for the two bivalves will permit collection of growth and mortality data equivalent to that obtained during the mussel study.

The benthic macrofauna in St. Margaret's Bay, Nova Scotia is dominated by sediment feeding invertebrates. Little information exists about a large proportion of these animals, particularly the polychaetes and amphipods and therefore a project intended to gather basic information on the behaviour, ecology and feeding mechanisms of the more important species has begun. Because the sediment is an important source of food for the majority of the infauna, its physical and biological characteristics have been examined.

#### Community Structure and Faunal Surveys

In anticipation of the completion of the Point LePreau Nuclear Power Plant in 1980 in New Brunswick, a base line survey of benthic macrofauna was funded by the New Brunswick Electric Power Commission.

#### Benthic Community Dynamics

Sedimentation studies in Bedford Basin, an enriched bay on which Bedford Institute is located, were completed during 1975. Comparisons of material caught in traps with that suspended in the water column during trap exposure demonstrated that only a few percent of total suspended particulate carbon, nitrogen was deposited daily. Chlorophyll a was lost from the water column at an order of magnitude lower rate except during winter (December-January) when direct sedimentation of dinoflagellates occurred. At all other times of year, material produced by phytoplanktons does not enter the benthos directly but has a residence time of up to several weeks in the water column before deposition. Sedimentation measured at different depths indicated that input of deposited material was not a vertical process.

#### Denmark

(E. Smidt)

#### Benthos

Studies of the benthic fauna composition have been initiated in the off-shore area of West Greenland where oil exploitation licences were given in 1975.

Tailings disposed of in the sea from a lead-zinc mine and mill in West Greenland have affected the local benthic fauna.

#### Finland

(J. Lassig)

#### Benthos

At the Institute of Marine Research the quantitative studies on the bottom fauna in the northern Baltic were continued in May, July, August, September and November. In co-operation with Tvärminne Zoological Station studies on benthic macrofauna were continued in the archipelago of Tvärminne. An intensive study on bottom fauna was carried out in the Gulf of Finland in July.

At the Tvärminne Zoological Station of the University of Helsinki macrofauna studies were continued at 14 stations in the harbour of an iron



mill in the vicinity of the Research station. Meiofauna studies were started on a soft bottom.

The National Board of Waters in co-operation with the Archipelago Research Institute of the University of Turku carried out routine control analysis in coastal waters of SW Finland at about 100 sampling stations. The influence of industrial pollution on benthic fauna composition off Pori, Bothnian Sea, was also studied.

At the Archipelago Research Institute of the University of Turku, laboratory studies of the influence of oil on some common bottom dwelling invertebrates of the Archipelago Sea were performed. Population dynamics of Mesidotea entomon (Isopoda) and Fucus vesiculosus (Phaeophyceae), ecology of littoral algae, including diatoms, in the Archipelago Sea were studied.

At the Husö Biological Station of Åbo Akademi macrobenthos samples have been taken at 20 fixed stations in the Archipelago of Åland. Effects of artificial wave exposure of ferry traffic on zoobenthos and phytobenthos have been studied.

At the University of Oulu studies on benthic macrofauna were continued in the Bay of Liminka.

At the Water Conservation Laboratory of Helsinki City macro- and meiobenthos studies were continued at 3 stations in the coastal waters off Helsinki.

At the Institute of Radiation Protection benthos studies were carried out around the siting places of the nuclear power plants. Samples have been taken 4 times during the ice-free period at 9 stations off Loviisa in the Gulf of Finland, and 3-5 times at 7 stations in the archipelago of Rauma in the Bothnian Sea.

#### France

(L. Marteil)

#### Ostrea edulis

Les études sur l'affection parasitaire qui frappe l'huître plate ont été poursuivies. Sur le plan épidémiologique, on constate que les huîtres élevées dans les grandes baies littorales, largement ouvertes, restent saines.

#### Crassostrea sp.

En dehors des observations faites sur les conditions de reproduction et de croissance, une étude a été entreprise pour déterminer à quelle espèce appartenait les différentes populations existant sur les côtes françaises. L'étude électrophorétique de l'A.D.N. a permis de distinguer nettement C. gigas et C. angulata qui seraient donc deux espèces différentes.

Pecten maximus.

Une étude comparative des stocks des différents secteurs bretons a été réalisée et des marquages effectués. Dans les mêmes secteurs des essais de captage ont été poursuivis ainsi qu'à La Trinité des expériences d'élevage de ce mollusque.

Stimultanément ont été captés sur les mêmes collecteurs Chlamys opercularis et Chl. varia. Faibles en général pour la coquille St. Jacques, les résultats ont été meilleurs pour le pétoncle.

Programme 1976

Poursuite des travaux sur l'identification des espèces d'huîtres creuses constituant les diverses populations élevées en France.

Evaluation de la capacité nutritionnelle du Bassin de Marennes-Oléron en relation avec les irrégularités de croissance et d'engraissement constatées ici et là chez C. gigas.

Poursuite des observations épidémiologiques chez O. edulis.

Poursuite des études de stocks et des essais de culture chez les pectinidés.

Federal Republic of Germany

(K. Tiews)

Molluscs

Mytilus edulis

Experiments on the raft culture of mussels were continued in the western Baltic (Flensburger Förde) at the Institut für Küsten- und Binnenfischerei.

Oysters

Raft and container culture experiments with Crassostrea gigas were continued at various localities of the Wadden Sea off the German North Sea coast and in the western Baltic at the Institut für Küsten- und Binnenfischerei.

Cockles

Cockle beds along the coast of Niedersachsen and Schleswig-Holstein were again surveyed by the Institut für Küsten- und Binnenfischerei. A commercial fishery, which started in 1973, was continued off the coast of Niedersachsen. In 1975, a commercial fishery was initiated off the coast of Schleswig-Holstein.

## Benthos

The Biological Station of Heligoland continued its sampling of benthic communities on special stations in the North Sea for the purpose of studying changes in species distribution and the dynamic aspects of the eco-system.

The Institut für Meeresforschung at Bremerhaven continued its study on the distribution of microbenthos in the southern North Sea with special emphasis on nematodes, fungi and bacteria. Studies on the development of benthos communities in a brackish water pound at the Institut für Küsten- und Binnenfischerei were discontinued.

The Institut für Meereskunde continued its studies on the availability of benthic food specimens in relation to its utilization by fish in the Kiel Bight.

## Studies Planned for 1976

### Cockles

Survey work on the size of cockle populations along the German North Sea coast shall be continued at the Institut für Küsten- und Binnenfischerei.

### Mytilus edulis

Experiments on the vertical mussel culture in the Flensburg fjord shall be continued by the Institut für Küsten- und Binnenfischerei.

### Oysters

Raft and container culture experiments with Crassostrea gigas in the Wadden Sea off the German North Sea coast and in the Western Baltic shall be continued. Work on the reproduction of C. gigas shall be initiated at the Institut für Küsten- und Binnenfischerei.

## Benthos

Benthos studies at the Biological Station of Heligoland, the Institut für Meeresforschung at Bremerhaven and the Institut für Meereskunde Kiel shall be continued.

## Iceland

(H. Eiriksson - U. Skúladóttir)

### Molluscs

#### Chlamys islandica

Collection of data on landings and effort was continued as before. Average catch per fishing hour in the major scallop fishery in Breidafjörður has increased from 535 kg in 1972 to approx. 650 kg in 1975. This is considered to be partly due to decreased effort in the last two years as well as improved dredging gear.

One scallop survey was carried out in the Breidafjörður area which included general sampling of the area.

Three scallop surveys are planned in 1976.

### Arctica islandica

Two surveys were undertaken including dredge experiments and assessments of the distribution and density of Arctica islandica. Experimental catches up to 300 kg/15 min. were obtained.

Research on this species will be continued in 1976, but however depending on the fishing industries interest in this prospective fishery.

### Mytilus edulis

Experimental rope culture was continued at three locations on the southwest coast.

## Ireland

(F.A. Gibson - C.B. Duggan)

### Oysters

The spat settlement of Ostrea edulis was again monitored in Tralee Bay. A heavy settlement took place during the first three weeks of July when the water temperature was about 18C. No settlement took place during the last week of July nor throughout all of August, although the water temperature remained above 18C reaching a maximum of 20C at the end of August. Survival and growth of the spat was good and polyethylene spat collectors of French manufacture were tried with excellent results.

## Netherlands

(P. Korringa)

### Molluscs

#### Ostrea edulis

Since the Dutch oyster industry is at least partly based on relaying of oysters produced in Brittany, the events in that region, especially where it concerns diseases and parasites, are of the greatest importance. Therefore the Netherlands Institute for Fishery Investigations paid special attention to the so-called "Aber disease" raging among the flat oysters. In the year 1968 the disease began to spread from the Aber Wrach estuary, first slowly, then more rapidly, to reach all the important oyster regions in Brittany in 1974. The disease is caused by a "new" haplosporidian parasite called Marteilia refringens, of which the biology and the factors affecting its spreading are still poorly known. Complete prohibition of importation of French stock for relaying would be the best measure to avoid outbreak of the disease on the Dutch oyster beds. It should be considered, however, that some oysters bearing the parasite had already been relaid in the Oosterschelde, which fortunately did not lead to an increased mortality rate. Taking into account the still modest stock of native oysters, the oyster farmers insisted on continuing to import stock from Brittany, be it

under scientific guidance, to minimize the risks. It was decided to impose no restrictions on importation of marketable oysters to be stored for a short while in the oyster basins during the winter season. In case analysis of samples of such oysters indicated quite a high infection rate, the oyster farmer was told to sell these oysters as soon as possible and to avoid carefully that any of this material will reach the farming plots. Since these events take place at low water temperatures the risk that the disease will spread from these storage basins is considered to be very small.

Greater care is required when it concerns importation of oysters for relaying. Then samples taken in Brittany are analysed histologically, and only in case the oysters are found to be free of the parasite, or when the infestation rate is very low (less than 10% of the oysters bearing the parasite) permission for importation is given. Several consignments of oysters were refused on this basis. The oysters arriving in the Netherlands were sampled again to avoid abuse. On two plots samples were taken with regular intervals of one week, one plot bearing imported Brittany oysters, the other bearing true Zeeland stock. The parasite is known to be active in summer and to sporulate early in autumn. Only 1.6% of the imported Brittany oysters appeared to carry the parasite, which evidently can stay alive during sojourn of the oysters on the beds in the Oosterschelde. The genuine Zeeland oysters appeared to be completely free of the parasite (250 oysters were all negative). Apparently the disease does not easily spread on the Dutch oyster beds. It is still mysterious why the parasite behaves so differently in Brittany, though the general ecological conditions are not very different from those in Zeeland. Studies on the biology of the parasite will be continued.

The sanitary control of oysters was continued in 1975; more than 95% of the samples analysed appeared to be free from faecal coli.

No dinoflagellate blooms were observed during the summer months; Prorocentrum micans occurred only sporadically. During September, however, Prorocentrum redfieldi suddenly increased in numbers in the Dutch coastal area, invading the Oosterschelde too. Tests with laboratory rats made clear, however, that this bloom did not lead to toxicity of the shellfish.

#### Mytilus edulis

The Mussel Experimental Station on the Isle of Texel continued its work on cleansing and storage of mussels. During the cleansing period the mussels free themselves from any sand particles which may have intruded in the interval space during fishing, but during the storage time after that the keeping qualities of the mussels are determined by a variety of factors. These factors include the ecological conditions on the growing plots, but also stress caused by fishing and other handling. Both in the laboratory and in the outdoor basins these phenomena were studied under experimental conditions and on technical scale. In this the normal horizontal flow of water in slightly sloping basins carrying 20-60 kg of mussels per m<sup>2</sup> was compared with a system in which the water flows vertically through a thick layer of mussels in a tank. Both elimination of sand and keeping qualities were studied. Special attention was paid to physiological differences in consignments of mussels from various plots in the Waddenzee and in the Oosterschelde.

Larval development and settling of mussel seed was studied from late in winter till early summer. Settlement was profuse in 1975. Growth was normal in the adult mussels, fattening came rather late due to high water temperatures in summer, but the quality reached in autumn left nothing to be desired.



A new development was technical experimentation with hydraulic dredges, both for marketable mussels and for harvesting mussel seed. A comparison of the effect of conventional dredges and hydraulic dredges on the condition of the mussels was deemed to be a necessity, but on the other hand one should study the effect of hydraulic dredges on bottom fauna and bottom configuration, before the industry will be permitted to use hydraulic dredges.

In the laboratory of the Mussel Experimental Station one worked at a programme on the metabolism of mussels under a variety of conditions. Important parameters used were the amino acids, whereas enzymatic processes were also studied in some detail.

#### Norway

(K.R. Gundersen - B. Bøhle)

#### Mytilus edulis

Small scale experiments on cultivation of mussels in Northern Norway continued in 1975.

A laboratory study of lead uptake in mussels at different temperatures and lead concentrations was performed.

No work on molluscs was carried out on the west coast of Norway during 1975.

#### Poland

(Not Reporting)

#### Portugal

(Not Reporting)

#### Spain

(H. Quiroga)

#### Ostrea edulis

The growth and mortality of three samples of flat oyster born in an English hatchery and imported to Spain has been studied. The growth of flat oyster spat reared in an experimental hatchery in the Ria de Arosa area was also studied.

Adaptation of flat oysters in the Mediterranean coast, Fangar Bay, Tarragona was examined.

Imported oysters growing on rafts on the Galician coasts have been examined in order to observe the possibility of diseases.

#### Crassostrea sp.

C. angulata pathology, especially of the digestive gland, epithelium alterations with possible modifications in the respiratory physiology, especially digestions based on pH and enzymes variations were studied. Tests in experimental conditions related to the development of the gonad in C. angulata and C. virginica were carried out.

#### Venerupis decussata

The Santander Bay populations have been studied, catch, size distribution, growth parameters and fishing effort were measured. The population density, distribution and abundance of this species has been studied too at different places on the Cantabric coast.

Tests were conducted on experimental conditions related to gonad development and growth.

#### Mytilus edulis

The growth and epifauna of mussels growing on rafts in the Ria de Arosa were studied and related to the energy flux in a raft. Eighty species of epifauna living on the ropes have been identified. The feeding of mussels based on comparative studies of the stomach content and the plankton composition have been studied also.

Mussel infestation by the copepod Mytilicola intestinalis was studied in the Ria de Vigo area.

#### Other Bivalves

The distribution of several bivalves of commercial importance were studied systematically along the Cantabric coast, with special attention paid to Santander Bay.

#### Cephalopoda

Identification and systematics of different species of Cephalopoda were studied by biochemical tests based on the examination of the soluble muscle protein fractions (electrophoresis).

Studies were conducted on the growth and reproduction of Octopus vulgaris, in the Atlantic and Mediterranean populations.

The Cephalopoda populations in the NW coast of Spain are being studied too.

The Cephalopoda populations of NW Africa based on the commercial catches and selectivity are being studied as well.

#### Benthos

The Ria de Vigo flora was studied, 130 new species of seaweeds have been found in this ria.

Several works on the ecology of the Foz beach (Cantabric coast) describing primary productivity, meiofauna, macrofauna communities and associated species, with special attention to those of more commercial importance.

Studies about Gelidium sesquipedale are continuing in the Cantabric coast. Environmental conditions, ecology, biomass and associated flora in the fields on exploitation, regeneration power, reproduction and agar-agar yield and oligoelements have been investigated during 1975.

#### Sweden

(H. Hallbäck)

#### Benthos

A big sampling programme of macro- and meiofauna among the "Baltic Marine Biologists" was finished during 1975. The final report will be published during 1976. Benthic organisms were studied in connection with several pollution investigations along the Swedish coasts. Diving was used to study the effects of warm water discharge from a nuclear power station in the area of Värö on macrobenthos.

United Kingdom

(H.J. Thomas - P.R. Walne)

Molluscs

Pecten maximus and Chlamys opercularis

Changes in the stock composition, catch and effort in the main scallop (P. maximus) fisheries were monitored. Detailed analysis and comparison of the data from the long-established Clyde fishery and the recent fishery west of Kintyre is in progress. The queen (C. opercularis) fisheries were similarly monitored.

Experiments were carried out to compare the efficiency of standard and spring-loaded toothed dredges and of standard dredges fished singly or in multiple, and to study the selective effect of tooth spacing and ring and mesh size on the scallop catch. The efficiency of the queen trawl in relation to the behaviour of the queen was studied by direct observation by divers, and means of improving the efficiency were investigated.

Growth experiments, on Chlamys opercularis, in cages have continued off Plymouth (South West England). Maximum growth occurs during the period May-August and queens settling at this time can reach the minimum commercial size (50 mm) in just over a year. Settlements have occurred in cages in most months except during winter - resulting in a very large size variation for any one "year class". Studies on the seasonal variation in muscle meat condition have indicated that the maximum yields are obtained between spring, and the end of the year, when the increase compared with winter is over 50% in wet weight (75% dry weight). Around 4,000 queens were tagged and released off Plymouth to obtain information on possible migrations.

Escallop, Pecten maximus, tag returns from coasts off South West England show that growth is relatively poor in this area, a mean, increase in length of only 4 mm being recorded more than 5 years after the tagging experiment (between the sixth and twelfth year of the scallop's life). Recorded movements have been small, over 75% of the returns being caught within 2 miles of the original position of release. During 1975, landings rose by 500% and the value of the catch exceeded £400,000. A detailed study has therefore begun especially of the younger stages.

Ostrea edulis

Spatfalls on most oyster grounds were poor in 1975. However, the general improvement of stock levels on most fisheries was maintained. There has been a heavy demand for seed oysters from the Solent fishery and these have been sent to various countries in Europe for relaying. Now that seed oysters from British hatcheries are becoming available the further development and expansion of Ostrea edulis fisheries appears promising.

Crassostrea gigas

Further advances have been made with techniques for growing hatchery-reared C. gigas. New methods for growing small seed have been developed and certain areas of the coast have been identified as highly suitable for growing this species. Studies showed that other areas, where the growth of C. gigas was poor, contained a high percentage of fine silt in suspension which is believed to affect growth. Numerous small scale commercial developments using this species are in progress and expansion of the production of C. gigas is steadily taking place.

#### Cerastoderma edule

Research in the two main fisheries, the Thames estuary and the Wash has shown that the fishing methods employed in these areas (hydraulic dredging and a method using the propellor called "blowing out") can result in a considerable mortality of young cockles. Cockle beds in both areas have therefore been closed to protect undersized stock. Surveys in the Burry Inlet, South Wales, showed that the 1975 settlement on the main commercial grounds was a failure and the future prospects for the fishery are poor.

#### Buccinum undatum

Trials have been carried out to test alternative baits to the expensive salted herring which is now widely used. Encouraging results have been obtained with various fish which are abundant and cheap at certain times of the year. These include blue whiting, scad, deepwater smelt and mackerel. Experiments will continue in 1976.

#### Mytilus edulis

Further studies of the damage caused by dropping mussels onto hard and soft surfaces have shown that small seed have similar damage rates to large mussels. A fall of 2m leads to 8-15% loss due to severe shell damage and about 20% of the undamaged mussels die within a week. The papain extraction technique has been used to examine large samples from Morecambe Bay for Mytilicola infestation. It was shown that 20mm relaid mussels had a 60% survival from July to October when relaid within a crab-proof fence.

#### Bivalve culture

Much interest is being shown by commercial operators in bivalve culture in Scotland. Experimental culture of Crassostrea gigas, Ostrea edulis, Pecten maximus and Chlamys opercularis was continued on rafts in five west coast lochs. In addition both species of oysters were successfully grown on the shore, where production should be less expensive. Growth, fattening and mortality were observed under a variety of conditions.

The distribution of pests and diseases was monitored, particularly at commercial and experimental sites. Imports and exports of oysters have also been examined for them.

#### Loligo forbesi

Landings and catch composition data of the squid (Loligo forbesi) were undertaken and further studies made on the distribution and biology of this species.

#### Shellfish pests and diseases

The stringent control measures which were introduced in 1974 to prevent the introduction and spread of new molluscan shellfish pests and diseases have proved to be successful. These controls prevent shellfish from contaminated areas being deposited in clean areas and have prevented the spread of "Aber disease" from Europe into England and Wales. Checks have continued to be made to ensure that there has been no spread in distribution of the drill Urosalpinx cinerea which is, at present, only found off the coasts of South East England. Experiments have been undertaken to develop a saturated brine dip for the removal of small slipper limpets (Crepidula fornicata) attached to hatchery seed molluscs.



## Benthos

During 1975 studies of intertidal benthos were made on flat fish nursery grounds in the Scottish east coast (Firth of Forth) and west coast (Firth of Clyde). Both meiofauna and macrofauna were studied, and particular attention was paid to the manner in which benthos fish food may be affected by polluted situations.

The long term survey of subtidal benthos on a sandy ground in Loch Ewe was continued, with the object of defining cyclic changes in the populations.

There has been little spread of the immigrant seaweed Sargassum muticum in 1975, although it has consolidated its position in the Solent area of the south coast of England. In an attempt to control its spread, during 1975 25 tonnes were removed by handgathering. Local scientists, backed by Government finance, are attempting to find a method of controlling the weed by hormonal interference in the breeding cycle.

## U.S.A.

(J.E. Hanks - J.B. Pearce - M.A. Trafford)

## Molluscs

All programs are continuing through 1976-1977.

### Spawning and Rearing of Molluscs

The objective of this investigation is to develop basic culture methods for bivalves of known or potential commercial value not currently being reared in commercial hatcheries. The bay scallop (Argopecten irradians) and the surf clam (Spisula solidissima) were selected for study. The bay scallop is a valuable species with an excellent market demand seldom satisfied by the wild harvests. Its rapid growth rate and early maturity make it a likely candidate for hatchery culture. The surf clam has been well received by the general public in recent years. Considering its hardiness and rapid growth in laboratory environments, its potential as an aquaculture species, generating new products from rapidly-grown, small-sized individuals, is being investigated.

Studies of environmental factors influencing survival and development of surf clam eggs and larvae in controlled environments show that the most consistent rearing success is obtained when an antibiotic is used prophylactically throughout the embryonic and larval stages. The antibiotic most effective for this purpose of those tested to date is Chloramphenicol.

Observations of post-set and juvenile surf clams in the laboratory show that they grow rapidly in favorable circumstances. Based on rates observed, we expect that clams spawned in late winter will average about two inches long by the end of the growing season in late fall.

Experiments with bay scallop culture indicate that gametogenesis in this species can be stimulated during the winter by the proper environment, thus extending the time during the year when spawnable animals are available for experimentation and mass culture.

Observations of juvenile scallops in the laboratory in warmed, raw, untreated seawater during the winter indicate that they will, with adequate food present, grow rapidly in this environment at a time when those in nature are not growing at all.



### Nutritional Requirements of Molluscs

Research has been reoriented toward aquaculture, although former studies on the effects of pollutants on phytoplankton are still continuing on a small scale.

Commercial shellfish hatcheries have consistently identified the area of nutritional requirements of larval bivalves in culture as one that needs more information. In fact, the development of this information is considered critical to the success of molluscan aquaculture. The intent of this investigation is to improve upon the methods of feeding in hatcheries, namely, using phytoplankton species as foods. We are seeking to improve upon the phytoplankton culturing procedures while more fundamental information on nutritional requirements is being sought.

Algal culture facilities have been increased so that an abundant phytoplankton food source is always available to aquaculture projects at the laboratory. Thirty carboys (5-gallon) in semi-continuous culture provide high-density axenic foods for larval and juvenile shellfish. Four fibre-glass tanks of 1500-liter capacity are maintained for the culture of mixed phytoplankton species fed continuously to trays of adult and juvenile molluscs. A novel method of maintaining stock cultures of phytoplankton, that is simple, inexpensive, and allows storage for long periods, has been developed. This should minimize the burden of maintaining stock cultures in commercial operations. Work is in progress to determine the minimum nutrient enrichment that is satisfactory for growth of algal cultures. A number of strains will grow in a vitamin-free medium. The reduction of the nutrient components to a minimum level should effect a considerable cost benefit in commercial aquaculture. Experiments are being conducted into long-term preservation of algal cells, which would ensure a uniform food supply and put the production of algal food cells on a more economical basis. Experiments are being conducted with oyster veliger larvae to develop highly critical methods for evaluating nutritional requirements. Fundamental information on nutritional requirements is dependent upon the development of such a system. A review of the subject of bivalve nutrition entitled, "Views on Bivalve Larvae Nutrition", was prepared for an International Symposium on Aquaculture Nutrition, University of Delaware, September 1975.

### Physiological Effects of Pollutant Stress

Juvenile bay scallops (Argopecten irradians) were exposed to mercury, silver, and cadmium for 96 hours. Fifty percent mortality occurred at 33 parts per billion (ppb) silver, 89 ppb mercury, and 1.48 ppb cadmium. Although the order of toxicity of mercury and silver has been reversed, as with clam and oyster embryos and larvae, these two metals are still highly toxic, while cadmium is relatively low in toxicity. Scallops exposed to the LC<sub>5</sub> and LC<sub>25</sub> values of cadmium for 96 hours exhibited significantly higher oxygen consumption rates than the controls. Scallops exposed to silver at the LC<sub>25</sub> level indicated elevated respiration, while those at the LC<sub>5</sub> level respired at a slightly lower rate than controls.

### Aquacultural Genetics

Experiments were conducted in oyster larval culture techniques for the commercial American oyster (Crassostrea virginica) to establish standard rearing procedures for future experimental genetic research.

A long-term selection experiment was begun. This experiment is aimed at critically examining and establishing selection criteria and techniques for use under commercial hatchery conditions for genetically improving market oysters.

American oysters are also to be inbred by full-sib crosses for one generation and inbred then cross-bred. The purpose is to evaluate this approach to commercial breeding and to measure inbreeding depression.

Hybridization of the oyster in its broadest context from intra- to inter-species hybrids is to be examined with crosses by hybrids with one another and backcrossing to common commercial stocks.

### Pathobiology Studies

This investigation involves four related research areas - rapid pathogen identification, disinfection and disease control, toxin depuration, and consultations/visits to solve commercial hatchery disease problems.

The A.P.I. and Minitec bacterial identification systems were checked for precision and repeatability in a rapid screening for marine shellfish pathogens and found to be useful, primarily for identification of Vibrio-like organisms.

In laboratory challenge experiments using bacterial pathogens and shellfish larvae, ionic silver solutions, various antibiotics and ozonized seawater were tested individually and synergistically to determine disinfectant efficiency. Results indicated that Neomycin was a most effective antibiotic for most pathogens. While rapidly sterilizing culture water, ozonization of seawater can produce long-lived bromo radicals, which may cause genetic damage to developing shellfish larvae. Experiments on the bacteriocidal use of silver will be continued as results are not conclusive.

Ozonized seawater was delivered to surf clams (Spisula solidissima) containing shellfish poison (Gonyaulax tamarensis) during tests of depuration. While all bacteria rapidly disappeared from samples of mantle fluid and stomach contents, only 40% of the poison was removed during two-week experiments. Once becoming toxic, surf clams can remain poisonous for 9-12 months, thus removing them from the fishery. Results indicated that ozonized seawater cannot rapidly remove shellfish poison from the surf clam.

Active communication with shellfish hatchery owners has been maintained by visits to some East and West Coast hatcheries. These visits were made to assist growers in identifying sources of marine bacteriological problems and to offer techniques for controlling pathogens in hatchery situations. Most recommendations made to growers involved implementing standard sanitary practices in the maintenance and rearing of shellfish larvae.

### State-Federal Program Activities - Region III National Marine Fisheries Service, Gloucester, Mass.

In 1972 the U.S. Government joined forces with the Atlantic coastal states to initiate a cooperative program to develop a coordinated, regional management system for selected fisheries. Of particular interest are the

coastal fisheries for northern shrimp, American lobster, and surf clam. Both the federal government and the states are financing work. Such work is also being done under contract with federal funds. All work is being done in a manner which focuses on common goals and objectives.

Direction for the program is provided through a council organization composed of administrators from each state and from the federal government. Scientific research, which serves as the basis for administrative decisions, is directed and coordinated by scientists selected from each state and the federal government. Significant scientific research is now providing the baseline data necessary for management action needed now and in the future.

A general account by species of the type of research, location, and present status is itemized as follows:

Agency	Title	Type	Duration	Status
Department of Marine Resources State of Maine	Lobster Research and Lobster Tagging (PL 88-309)	Biological studies including growth, mortality, migration, and stock assessment	5 years	ongoing
Department of Fish and Game State of New Hampshire	Lobster Research (PL 88-309)	Biological studies on wound induced pathology and gear related mortality	1 year	concluded
Department of Natural Resources State of Massachusetts	Lobster Investigations in Southern Gulf of Maine, Pilgrim Power Plant Impact Studies, Lobster Hatchery	Biological studies on growth, migration, recruitment, distribution, population dynamics, gear efficiency, and mariculture	annual	ongoing
Department of Natural Resources State of Rhode Island	Study of the Inshore Lobster Fishery of Rhode Island Sound	Biological studies on growth, migration, distribution, population dynamics, and exploitation	2 years	ongoing in last year
University of Rhode Island State of Rhode Island	Bioeconomic Analysis of the Massachusetts Inshore Lobster Fishery	Economic analysis of existing fleet and expected returns with various levels of effort	1 year	concluded
Herr Associates, Inc. Providence, Rhode Island	Constituent Attitude Regarding Management Changes	Sociological evaluation of public attitudes regarding management changes	6 months	concluded
Department of Environmental Protection State of Connecticut	Long Island Sound Lobster Management	Statistical analysis of mandatory catch/effort reports	annual	ongoing in second year

Division of Marine and Coastal Resources State of New York	Aspects of American Lobster in Long Island Sound (PL 88-309)	Biological studies of growth, size at maturity, catch composition	3 years	ongoing in second year
Division of Fish, Game and Shellfisheries State of New Jersey	Management of Lobsters off New Jersey	Biological studies of growth, size at maturity, distribution, catch composition, and migration	3 years	ongoing in second year
Virginia Institute of Marine Science State of Virginia	Biology and Management of American Lobster	Biological studies of growth, sexual maturity, catch composition, and migration	3 years	ongoing in second year
Division of Commercial and Sports Fisheries State of North Carolina	Biological Studies of Offshore Lobsters	Biological studies of distribution, catch composition, and migration	annual	ongoing
Northeast Fisheries Center, NMFS Woods Hole, MA	Lobster Studies	Stock assessment, age and growth, and gear efficiency	annual	ongoing
<u>Surf Clam</u> Rutgers University State of New Jersey	Surf Clam Management Project for New Jersey	Biological studies of Surf Clam stocks within State jurisdiction including standing stock estimate	3 years	ongoing in last year
Brooklyn College State of New York	Inshore Inventory of Surf Clams Along the Long Island Coast	Biological studies including standing stock estimate	1 year	concluded
Virginia Institute of Marine Science State of Virginia	Inventory of Surf Clams in Nearshore Waters from Cape Henlopen to the False Cape Area	Biological studies including standing stock estimate	1 year	concluded



Virginia Institute of Marine Science	Alternative Surf Clam Management Measures	Socio-political evaluation of alternative ways to control effort and yield	1 year	concluded
Virginia Institute of Marine Science	Analysis of Historical Surf Clam Statistical Records	Statistical analysis of existing data	1 year	ongoing
Maryland Department of Natural Resources State of Maryland	Support to Surf Clam Management	Managerial support	annual	ongoing
Middle Atlantic Coastal Fisheries Center NMFS, Sandy Hook, NJ	Resource Assessment Surf Clam	Biological studies of age, growth, reproduction, dis- tribution, mortality and stock assessment	annual	ongoing
<u>Shrimp</u>				
Department of Natural Resources State of Maine	Shrimp Resource Assessment	Biological studies, growth, reproduction, distribution, population dynamics, stock assessment	annual	ongoing
University of Maine State of Maine	Support to Shrimp Management	Economic evaluation of industry impact with and without fishery regulations	1 year	ongoing
Division of Marine Resources State of Mass	Support to Shrimp Management	Distribution, population dynamics, stock assessment relative to fishery regulations	3 years	ongoing
National Marine Fisheries Service Gloucester, Mass	Support to Shrimp Management	Comparative mesh trawling experiment	1 year	concluded

### Benthic Programs

Because of the important relationships between environmental deterioration and pollution and benthic community structure, increasing numbers of benthic programs have been oriented towards revealing the impact of man's activities on coastal waters. Other benthic studies are being conducted in an attempt to determine the relationship between benthic production and marine fisheries.

Personnel assigned to the Northeast Fisheries Center, National Marine Fisheries Service, Woods Hole, Massachusetts, are studying a series of 600 quantitative benthic samples collected with grab samplers at depths of 3 to 3100 m. The original collection was completed in conjunction with the U.S. Geological Survey. Densities and biomass of major taxonomic groups are being analyzed with special emphasis given to the relationship between water depth, sediment grain size, sediment organic matter and geographic distribution.

Personnel of the Middle Atlantic Coastal Fisheries Center, National Marine Fisheries Service, Sandy Hook, are investigating benthic community structures found in the Middle Atlantic Bight. Scientists have completed analyzing replicate grab samples collected quarterly at over 100 sampling stations located in the New York Bight apex. This area receives a large portion (>80%) of contaminated dredging spoils and sewer sludge annually disposed of in North American coastal waters. The data are being developed to facilitate multivariate analyses involving sediment type, heavy metal and hydrocarbon distributions, water depth and other physical/chemical parameters. In addition to the work in the New York Bight apex, scientists have completed two major cruises in waters up to 3000 meters beyond the mouth of the Hudson Canyon. Over 100 stations are also being sampled on the continental shelf between the Bight apex and abyssal waters. These stations are located in the Baltimore Canyon Trough and alternative waste disposal sites. In addition to these offshore studies, indepth investigations are underway in Raritan Bay and Long Island Sound, particularly in the Thames River estuary located off New London, Connecticut. Center personnel are studying the impact of contaminated dredging spoils on benthic community structure and finfish distribution.

Scientists associated with the Virginia Institute of Marine Science are investigating the distribution and structure of infaunal communities in the Chesapeake Bay estuary. These scientists are also studying the macro- and megabenthos likely to be affected by drilling at oil development sites located on the Atlantic continental shelf from New Jersey to Virginia. Twenty-four stations are sampled quarterly with a quantitative grab sampler. Sediments are also being analyzed for grain size, organic carbon, trace metals and hydrocarbons.

Personnel from the University of Delaware have, for the past three years, been involved with benthic studies in Delaware Bay. Stations located on 13 transects on Delaware Bay have been sampled for benthic macrofauna. In addition, sediments from each station have been analyzed to relate the distribution of benthic fauna to sediment types. These studies are being conducted in advance of the development of new port facilities and other environmental alterations.

Scientists working at Florida State University, Tallahassee, have been conducting studies in the Gulf of Mexico designed to document the impact of development on coastal environments. The areas being studied constitute the third largest fishery area in the State of Florida and yields some 80% of Florida's oysters. Two bays are being studied, Apalachee and Apalachicola. The study of benthic macrophytes is emphasized in Apalachee Bay; the study is being done to document the effects of pollution abatement in an area previously affected by pump mill effluents. Benthic infauna studies are emphasized in the investigation ongoing at Apalachicola Bay. The latter study was initiated in 1971 and in addition to the biota some 20 physical/chemical parameters are being investigated.

The Southern California Coastal Water Research Project is continuing studies of the effects of ocean pollutants, especially ocean outfall pipes on benthic community structure off Orange Co., California. The benthic studies emphasized changes in sediment type which might result from pollution and consequent change in benthic community structure. These and previous studies suggest that benthic infauna and sediments may return to normal within a year following termination of discharge. The benthic studies are tied into physical/chemical studies as well as intensive studies of finfish abundance, distribution and disease.

New national legislation concerned with ocean dumping in the coastal zone has resulted in the implementation of numerous generic studies by the U.S. Environmental Protection Agency and the National Oceanic and Atmospheric Administration. These studies are concerned with the impact of contaminated dredging spoils and sewer sludge on specific environments. The Bureau of Land Management, U.S. Department of Interior, is also funding studies concerned with possible impacts of offshore oil development on benthos and other marine life.

#### U.S.S.R.

(P.A. Moiseev)

#### Molluscs

In 1975 pelagic squid of the tropical Atlantic, squid, octopus, cuttlefish of the West African shelf and bathypelagic shrimp were studied. A total of 7500 specimens of squid, octopus and shellfish species were collected and examined for a complete biological analysis; the stomach contents of 660 cephalopoda and shrimp specimens were also examined; an helminthological analysis of 1200 squid specimens of the Ommastrephidae family was made.

The behaviour of the squid, Stenoteuthis pteropus, was studied. Squid schools were labile in time and space, in terms of size and form. The age, interpopulation and biotopic variability of the schooling pattern has been revealed. From data on squid behaviour, methods have been developed for making quantitative counts of the species from a drifting or running vessel.

Reproduction of Illex coindetii takes place over the greater part of the year. In terms of maturation rates two groups can be distinguished in each area - fast-maturing and late-maturing squid.

A feeding diet of Illex is represented by various crustaceans, small fish and squid. The major factor determining a feeding range is accessibility of feeding objects.

CRUSTACEA

Belgium

(R. de Clerck)

Crangon crangon

The monthly analyses of the shrimp-stock and of the by-catch of experimental shrimp fishing were continued in 1975. These investigations were already started in April 1973. The final objective of this study is 1) to obtain a detailed picture of the evolution of the population of Crangon crangon along the Belgian coast over an extended period and 2) to evaluate the competitive and predative interactions between the population of Crangon on the one hand and the populations of the other species from the shallow water community on the other hand. Within the framework of this last study stomach analyses on about 1250 Gadus luscus and on about 2500 G. merlangus have been performed and stomach analyses on G. morhua, Liparis liparis and Onos mustelus were started in order to evaluate the importance of post-larval Caridean shrimps in the food of these fish species.

In 1976 the analyses of the shrimp-population will be continued. The investigations on predatory fishes will be extended to Callionymus lyra, Agonus cataphractus and Trigla species.

Nephrops norvegicus

The commercial catch of Nephrops norvegicus has been sampled on a monthly basis. Individual measurements were made of total length and carapace length.

Selectivity studies will be carried out on board a commercial vessel in 1976.

Canada

(J.E. Stewart)

Homarus americanus

The preliminary report of the 14-man Lobster Task Force was discussed with the industry and government officials in Halifax in mid March 1975. On the basis of this meeting, a revised 180-page final report on the status of the lobster fishery and recommendations for future regulation together with a 40-page summary was prepared for distribution and submission to the Minister by early April 1975

Monitoring of the fishery in selected Newfoundland areas was continued. This included catch sampling and collection of catch/effort data throughout the fishing season and counts of traps in use during the peak fishing period. Studies of growth in nature were continued with the emphasis being placed on obtaining reliable molt frequency data; associated with this was an attempt to validate shell condition determinations made by external observation. Tagging

was carried out in four areas to obtain estimates of commercial stock sizes and rates of exploitation during the 1975 fishing season. During 1976 the same program will be repeated.

Larvae were reared and observations made on their swimming behaviour in water currents and a study of the effect of wind on the abundance and distribution of larvae in a near-shore area was continued. Further studies of larval distribution are planned for 1976.

Also planned is a study of effective trapping distance for lobsters. This will be an attempt to determine optimum trap density on the fishing grounds.

#### The 1975 Northumberland Strait Project

The first year of a 2-year study on shellfish resources of the Northumberland Strait was completed during the summer of 1975, based on cooperative funding by DOE (St. Andrews Biological Station), and the provincial departments of fisheries of New Brunswick, Nova Scotia, and Prince Edward Island. The 1975 project aimed at a broad-scope survey of the Strait to collect information from a wide spectrum of physical and biological parameters relevant to the life history and production of shellfish, especially lobsters, crabs, and scallops.

The project has also been successful in establishing a first baseline for the study of the physical environment of the Strait, which will be of considerable value in studying effects of pollution, and of evaluating potential effects of other users of the marine environment on the fisheries of the Northumberland Strait.

#### The 1975 Field Program

Ninety-six stations, chosen along 12 transects crossing the Strait from P.E.I. to the mainland, were occupied by the M.V. "Harengus", and then by four lobster boats, chartered by the three Maritime Provinces. The "Harengus" collected data on the oceanographic and sedimentary regime, took grab samples for bottom fauna, and trawled for shellfish, groundfish and marine plants. The same stations were occupied twice by the lobster boats fishing standard lobster gear; detailed observations were made on the lobsters and crabs taken. The project was successful in obtaining information from all stations, and it is expected that when data analysis is complete, we will have an opportunity to detect interrelationships between commercial shellfish and their environment which will be of value for future management of the resource.

#### Inshore and offshore lobster study

An electrophoretic study of an inshore and an offshore lobster population from the south shore of Nova Scotia indicates that there are no genotypic differences between the populations. Thus offshore fishing of mature lobsters may well affect the numbers of the inshore population.



### Nutrition

Methionine and phenylalanine were shown to be essential in the diet of juvenile lobsters while cystine and tyrosine were non-essential.

Feeding trials with protein types showed casein to be better than soy bean protein as the only dietary protein whereas codfish protein resulted in 100% mortality when fed as the only dietary protein.

The growth rate of juvenile lobsters is much accelerated by eyestalk ablation. Because of the faster growth rate in eyestalk ablated lobsters they are more sensitive to dietary deficiencies and are being used as test animals in nutrition studies.

### Disease

Work on the fatal bacterial infection of lobsters, gaffkemia, is continuing and is concentrated chiefly on defense mechanisms against disease and the means to enhance these through use of vaccines. The results to date have been encouraging. Additionally epizootics in commercial units have been examined and advice given. No increase in the natural incidence was observed in limited surveys of the past year.

### Culture

An experiment is being conducted to determine the feasibility of growing canner (2-1/2" carapace length) lobsters rapidly to market size (3-3/16" carapace length) by eyestalk ablation and feeding an adequate formulated diet.

### Cancer irroratus

A study of seasonal occurrence of Cancer irroratus was done by trapping on different bottom types and depths in Northumberland Strait (southern Gulf of St. Lawrence). Sampling included size, sex, presence of berried females, moult stage, and epibionts.

Along with the sampling, 4,330 Cancer irroratus were tagged with t-bar tags (Floy model FD67) through the epimeral line.

To compare the quick-to-apply t-bar tag with the suture tag, 640 crabs with t-bar and 607 with suture tags were tagged and released in Northumberland Strait. Preliminary laboratory tests with the two types of tags indicated equal retention in tanks, though molting did not occur during the holding period.

### Chionoecetes opilio

Mesh selection experiments in Newfoundland using stretched mesh sizes of 91, 119, and 129 mm demonstrated that the largest mesh size would catch fewest sub-commercial crabs (<102 mm carapace width) without sacrificing catches of commercial crab. Neither trap soak time, crab shell hardness, nor total crab catch per trap had an important effect on mesh size selection.

In the laboratory growth per molt of sexually immature crabs decreased with increasing size from 40% to 25% carapace width. The female molt to maturity was a 15% increase and mature males increased 18% per molt.

Crab fishery regulations were reviewed for six fisheries to provide a collation of management options. Management problems were grouped into categories of conservation, allocation of landings among commercial fishermen, stability of landings, conflict over grounds or resource, processing economics, and administration.

Monitoring of shell condition throughout the seasonal cycle in a Newfoundland east coast population was started in the fall and will continue in 1976.

In July 1975, 4,030 snow crabs were sampled from commercial catches in the Gulf of St. Lawrence. Comparison with previous sampling in the late 1960's indicates a decrease in catch per unit effort and decrease in size of animals.

#### Pandalus borealis

Monitoring of the developing fishery for shrimp in the Esquiman Channel of the Gulf of St. Lawrence was continued in 1975. The fishery, which started in 1970, has expanded rapidly with approximately 30 vessels landing 1360 tons in 1975. A research vessel cruise and exploratory fishing showed commercial quantities of shrimp at several localities in Hawke Channel, Labrador.

A research vessel trip to the northern Gulf of St. Lawrence is planned for 1976. Emphasis will be placed on an assessment of the shrimp resource in the area as well as the effects that an extensive small mesh fishery might have on the recruitment of redfish.

#### Denmark

(Home waters - S. Munch-Petersen  
Greenland waters - E. Smidt)

#### Nephrops norvegicus

Three cruises were made in Kattegat during 1975 for the purpose of investigating the activity of Norway Lobster (Nephrops norvegicus) related to 1) day and night (light intensity), 2) current velocity, 3) oxygen content just above the bottom surface.

These investigations are to be continued in 1976.

#### Chionoecetes opilio

Trap fishing experiments for queen crabs have been continued at West Greenland.

### Pandalus borealis

Collection of catch-effort data from the commercial fisheries in in-shore and off-shore West Greenland waters has been continued, but the available data are still incomplete and do not allow reliable estimates of the exploitation.

Other methods used to study the biology and population dynamics were:

1. Sampling from commercial and research fisheries for calculation of year-class strength and mortality.
2. Bottom photography to study the density of the shrimps (ab. 2000 pictures have been taken).
3. Tagging experiments (ab. 10,000 shrimps were tagged in Disko Bay in 1975).
4. Echo survey to study the extension of fishing grounds.
5. Plankton survey to study the distribution and abundance of shrimp larvae.

The results are not yet available, and the research is to be continued.

Precautionary TACs for the off-shore shrimp fisheries were calculated based on the total area of the off-shore fishing grounds and the present yield per area unit in Disko Bay, where the catch is presumed to be near maximum sustainable yield.

### Finland

(Reported on Benthos Only)

### France

(J. Audouin)

### Langoustines (Nephrops norvegicus)

#### Travaux à la mer.

Des échantillonnages à bord des bateaux commerciaux ont été effectués dans le nord du Golfe de Gascogne; ils ont été réalisés bi-mensuellement dans une zone centrée sur 47°40' N et 4° W. Au printemps, dans le même secteur, une campagne a été consacrée à la sélectivité des diverses parties du chalut et de la survie des langoustines hors taille rejetées à la mer. En automne, une seconde mission a permis de commencer l'étude comparative des rendements du chalut à langoustine équipé alternativement du maillage toléré de 40 mm et du maillage réglementaire de 60 mm.

#### Travail au laboratoire.

La biologie de la langoustine et plus particulièrement sa croissance a été étudiée à l'aide des échantillons prélevés dans le Golfe de Gascogne. L'étude de la prise par unité d'effort a également été commencée.

Echantillonnage.

Région	Nombre d'échantillons			Nombre de langoustines échantillon.
	Bateaux commerciaux	Bateaux de recherche	marché	
Golfe de Gascogne	48	59	2	54,216 35,383 552

Le programme de 1976 prévoit la poursuite des échantillonnages bi-mensuels à bord des bateaux commerciaux et de l'étude des stocks du Golfe de Gascogne et du nord du 48ème parallèle.

L'analyse comparative des rendements des chaluts équipés du maillage toléré et du maillage règlementaire sera poursuivie au cours de deux campagnes, l'une au printemps dans le Golfe de Gascogne, l'autre en été sur le Plateau Celtique.

Homards (*Homarus gammarus*)

Les opérations de repeuplement des zones côtières par l'immersion de post-larves produites en écloseries ont été poursuivies. Le niveau de production des écloseries de l'Ile d'Yeu et d'Houat a été maintenu (240,000 en 1975).

Des échantillonnages ont été réalisés lors des prospections faites à bord d'un bateau de pêche en mai et juillet dans le secteur de l'Ile d'Yeu (N = 677).

Le contrôle des apports a été entrepris dans diverses régions, principalement à l'Ile d'Yeu et Roscoff (Institut des Pêches Maritimes) et à l'Ile d'Houat (COB).

Le programme 1976 prévoit la poursuite des recherches menées par l'Institut des Pêches Maritimes sur la biologie du homard (croissance, reproduction, possibilité d'hybridation, pathologie) et la collecte des données concernant les apports.

Araignée de mer (*Maia squinado*)

L'Institut des Pêches Maritimes a poursuivi et intensifié l'étude de la pêcherie d'araignées du Golfe normano-breton qui a porté sur la structure de la population adulte, l'évolution des apports et les déplacements (680 araignées ont été marquées dans ce secteur).

Des marquages ont été également effectués en Baie de Morlaix (N = 370) et à l'Ile d'Yeu (N = 219).

Ces résultats seront complétés en 1976.

Crevettes bouquets (*Palaemon serratus*)

Dix-huit cent crevettes ont été marquées à l'aide de colorants biologiques en vue d'étudier les déplacements de ce crustacé (secteur de l'Ile d'Yeu).

Federal Republic of Germany

(K. Tiews)

Crangon crangon

Investigations of the Institut für Küsten- und Binnenfischerei to assess the shares of undersized protected fish in the catch of the German shrimp fishery and the fluctuations in the abundance of fish species found on the shrimp fishing grounds were continued. A total of 390 samples (=1,950 kg) of unsorted catches of the shrimp fishery were collected in Büsum, Cuxhaven, Neuharlingersiel, Dornumersiel, and analysed as to species and length composition. The prey-predator relationship in the Crangon fishery has been studied.

Pandalus sp.

Samples of deep sea prawn catches made on the occasion of research cruises of FRV "Solea" in Farn Deep area and on the Fladen Ground were analysed as to their species and length composition at the Institut für Küsten- und Binnenfischerei.

Studies planned for 1976

Crangon crangon

Catch assessment work to determine the composition of shrimp catches by species and length shall be continued at the Institut für Küsten- und Binnenfischerei.

Pandalus sp.

Research on the composition of Pandalus catches in the North Sea shall be continued as well as food investigations at the Institut für Küsten- und Binnenfischerei.

Iceland

(H. Eiriksson - U. Skúladóttir)

Pandalus borealis

During the year new inshore fishing grounds were found. These yielded several hundred tons during the year.

Research has been carried out along the same lines as before. In addition collection of shrimp larvae has begun. Management of the fishery is similar as before and catch quotas are decided for the best known fishing areas.

In 1976 research on Pandalus will be carried out along the same lines.

Nephrops norvegicus

Three research surveys were carried out in 1975, including exploratory fishing on new grounds and general sampling of Nephrops. Limitations on sizes of boats was continued as in 1974. Moreover the catch quota was made smaller than expected due to unfavourable markets for small Nephrops in Europe. The annual catch was approx. 2,400 tons as compared with 1,983 tons in 1974.

Two Nephrops surveys are planned in 1976.



## Ireland

(F.A. Gibson - C.B. Duggan)

### Lobsters

During the 1975 lobster season (April - September) a cash reward of one pound (£1) plus the current market price of the lobster was offered to the fishermen for the return of tagged (branded) lobsters at Kilmore Quay, County Wexford, 500 of which were tagged in October 1974. A total of 144 or 28.8% (out of which 31 or 21.5 % were caught for a second time) were recaptured. A total of 82 (72.6 %) of the first time recaptures had moulted. All of these lobsters were checked, marked again and returned to the sea within a week of recapture. It was found that hot iron branding alone was not a very satisfactory method as the marks appear as faint blue lines after the moult and are not very easy to see. In lobsters which did not moult the shell had broken or cracked at the branding marks, but this did not seem to have had any adverse effect on the lobsters.

## Netherlands

(P. Korringa)

### Crangon crangon

The investigations on the distribution pattern and migration in the brown shrimp were continued. Data collected in the severe winter of 1962-1963 were compared with those collected in the average winter 1972-1973, and in the unusually mild winter 1974-1975. The results of these studies on the seasonal migration in this species will be published in the course of 1976.

The method developed in the Netherlands Institute for Fishery Investigations for measuring the physiological condition of individual shrimps to study migration and distribution patterns was also applied on consecutive waves of migrating specimens of Penaeus braziliensis. This was done in a research project set up in northern Brazil, in which the Dutch shrimp biologist was the project leader. The preliminary results show a striking similarity of the migration pattern of Penaeus braziliensis with that of Crangon crangon, in spite of the fact that the factors triggering off migration are probably completely different.

Catch forecasts for the landing of shrimps by the Dutch fishermen appeared to be amazingly precise in the year 1975. The landings amounted to 5.81 million kg of shrimps of which 1.2 million were caught in the German Bight. The published forecast was 5.8 million kg total of which 1.3 million kg was predicted to come from the German Bight. For the year 1976 the forecast is considerably higher: a total of 7.7 million kg.

The technical development in the shrimp industry continued. An automatic transporter to transfer the catch to the sorting machine came into commercial use. The results obtained with this device exceeded the already optimistic expectations. Not only did it reduce considerably the manual labour, but it turned out that there was also a marked improvement in the quality of the catches. When the automatic transporter is used in combination with the automatic sorting machine, protection of undersized flatfish and small shrimps is even under unfavourable weather conditions almost 100%, since the catch is transferred to tanks with running sea water. A conveyor belt brings the catch from these tanks into the sorter. Due to the regular input of the catch in

the sorting machine selection is very efficient, which results in a higher tonnage of marketable shrimps sorted out from the catch, and a smaller amount of undersized shrimps. A further improvement in the quality of the marketable shrimps can be obtained by skimming off sprats and gobids from the sea water tanks with the aid of a dipnet.

#### Norway

(K.R. Gundersen - B. Bøhle)

#### Homarus gammarus

The lobster investigations in the field were only carried out with fishing experiments on the tagging localities north and south of Bergen in May, June and July.

The commercial spring lobster catches on the coast line from Fedje in the north to Krossfjord in the south were investigated at a lobster pond south of Bergen. Carapace length, sex and amount of berried females were observed.

Data on catch and effort from local fishermen on the South-East Coast is obtained every season. This type of data from 1928 onwards are now under preparation and will be presented on the Special Meeting on "Population Assessments of Shellfish Stocks".

Tagging experiments on the South-East Coast, initiated in 1973, are under continuous observation.

Observations on increases in length during moulting of lobsters in captivity were continued.

Hatching and rearing of lobster larvae were carried out on a small scale in the laboratory. Studies on the growth of juvenile lobsters in the laboratory were continued in 1975 and will be continued for another two years.

#### Cancer pagurus

In order to investigate the stock of the edible crab, large enough for economical exploitation by fishing in the northern part of Norway, fishing experiments with crab pots started in the neighbourhood of Bodø in the autumn of 1975.

In addition, data of size, sex and condition were collected.

#### Pandalus borealis

The work with a prawn sorting trawl was continued during 1975, and fishing experiments were carried out in order to find unexploited areas for deep sea prawn fishing in the Barents Sea.

The laboratory studies on development and hatching of eggs on females were concluded in March 1975, though additional studies on variation in hatching time and the percentage of hatching of eggs between single individuals also were performed in the season 1975/76.

In 1975 and 1976 investigations on the larval development has been performed, with most success in 1976. In connection with this, sampling in the sea on the commercial fishing ground off Flødevigen were performed for ecological studies, i.e. vertical distribution and migration.

Poland

(Not Reporting)

Portugal

(Not Reporting)

Spain

(H. Quiroga)

Nephrops norvegicus

Catch, effort and size distribution of the Nephrops populations are being studied for the following statistical regions: VII b, c, j, k, VIII c, and IX a. Age, gonad maturation, sex ratio and selectivity are being studied too.

Micropipus sp.

Size, age composition and distribution of the populations of the genus Micropipus in the Ria de Arosa have been studied during 1975.

Other crustaceans

The fishery of the following species, Parapandalus narval, Plesionika edwardsii and Heterocarpus ensifer around the Canary Islands have been studied. Age, size, maturation and distribution were the parameters studied.

Sweden

(H. Hallbäck)

Homarus gammarus

The Swedish lobster fishery still showed low landings during 1975. Some investigations on the behaviour were carried out by diving, specially concerning the effects of warm water discharge and of polluted water.

Cancer pagurus

Collection of catch and effort data from commercial boats was continued and the catches of the crab fishery have increased during 1975. Investigations concerning the effects of warm water discharge and polluted water on crabs were carried out by diving in the area of Värö.

Nephrops norvegicus

Daily reports were obtained from a number of trawlers including bycatches. The landings of the fishery have increased during 1975. Biological samples were taken every month from trawl catches.

Pandalus borealis

Continued data collecting for assessment use. Samples taken from commercial catches and research vessels were measured and sex determined. During the autumn a considerable increase in the proportion of primary females was noticed. This can be a consequence of a too high exploration rate.

United Kingdom

(H.J. Thomas - P.R. Walne)

Homarus gammarus

Sampling of the commercial landings of lobsters in Scotland was undertaken for all the main fishing areas and catch/effort compiled from observations made by fishermen observers.

The collection of catch-effort data and population structure (size composition and sex ratio) has continued in England and Wales in all the major lobster fisheries. Field and laboratory studies have enabled further development and testing of a toggle-type persistent tag. Diving techniques were used to search for juvenile lobsters and to observe diurnal activity and behaviour to pots. Discussions with the fishing industry resulted in acceptance of the recommendation to adopt carapace length at 80 mm as the national minimum size.

Cancer pagurus

Monitoring of the population structure and collection of catch-effort information has continued in several fisheries. Further recaptures of suture-tagged crabs has helped to establish stock relationships and migratory patterns in the English Channel. Following the completion of the extensive study of the major fishery off south-west England management proposals, based on a yield assessment model, have been put forward for consideration.

Collection of size composition and catch/effort data was maintained in the main Scottish fisheries. Returns of tagged crabs continued and are being analysed.

A preliminary study of crab behaviour was commenced, using acoustic tracking techniques.

Nephrops norvegicus

During a research vessel cruise in the Farn Deep off the north east coast in October, surveys were made of the spatial distribution of the stock. Results suggested that on the main commercial fishery ground there has been a further slight reduction in mean size since the last survey in 1974. On the same cruise, an investigation of the cod predator/Nephrops prey relationship was continued, and 1,000 large and medium Nephrops were claw-tagged to investigate migrations. To date (March, 1976) there have been no recaptures. Details of catch per unit of effort and landings are collected from this fishery and a detailed analysis of these data suggests a long-term inverse relationship between the volume of landings and the duration of sunshine.

The commercial catch of Norway lobsters was sampled aboard commercial vessels operating on all the major Scottish fishery grounds. Catch and effort data were compiled. Further research vessel experiments were undertaken on the effects of using cod end covers and a comparison made of the escapes from trawls of 50 mm and 70 mm mesh. Further studies by diving were made on the behaviour of Norway lobsters particularly in relation to their burrowing habit in response to light and currents.

A study was made of the by-catch of fin fish in the Scottish Nephrops fishery.



### Pandalus borealis

Sampling of the fishery by Scottish boats on the Fladen ground was maintained and the collection of catch/effort data continued. Research vessel studies of the composition of the Farn Deep stock were combined with studies of mesh selection recommended by the ICES Pandalus working group.

Surveys have shown that the population in the Farn Deep area off Northumberland is subject to considerable changes in abundance. This factor, together with the lack of processing and peeling facilities in the area have restricted the development of a fishery by British Vessels. A limited research programme has included a study of the distribution of the various year classes; it was observed that the spatial distribution of the brood was markedly different from that of the 1 and 2 group females.

### Pandalus montagui

The increase in stock density in the Wash fishery off the east coast has continued and landings at Kings Lynn, the main port in the area, have reached their highest for the last decade. Landings for the last three years were:

1973	426,000 Kg
1974	396,600 Kg
1975	552,750 Kg.

This is the only viable commercial fishery for P. montagui in England and Wales. Studies on this important fishery have continued and random samples have been examined for length and sex frequency.

The investigation of lipid content reported to ICES (C.M. 1972/K:18) has been repeated during 1975 using dry weight rather than wet weight. Sampling has been extended to include hepatopancreas, gonad and the egg mass of gravid females.

### Crangon crangon

Catch/effort and stock composition data were collected from the small Solway Firth fishery.

### U.S.A.

(J.E. Hanks - J.B. Pearce - M.A. Trafford)

### Lobsters

Lobsters (Homarus americanus) chronically exposed to sublethal amounts of cadmium had elevated rates of gill-tissue oxygen consumption, as well as a loss of magnesium sensitivity in heart muscle transaminase. In the gills of cadmium-exposed lobsters, levels of that metal were significantly higher than in control animals; the gills also showed some indication of increased ATPase activity. Exposure to similar levels of mercury had a lesser effect on the magnesium sensitivity of heart AAT, and none at all on gill-tissue respiration, although very high levels of this metal were detected in gills, digestive gland, and tail muscle. Neither metal affected serum osmolality, and very little difference was found in any test when data from 30- and 60-day exposures were compared.



U.S.S.R.

(P.A. Moiseev)

Shrimp

In 1975 bathypelagic shrimp of the Atlantic tropical West African shelf were studied. Twelve hundred specimens of 5 species of shrimp were given a complete biological analysis including an examination of the stomach contents of a proportion of them.

From the critical analysis of literature sources and our own data keys have been established for determination of the world fauna of shrimp of the Segrestidae, Oplophoridae, Pasiphaeidae families to within a species. New data on distribution and ecology were obtained for some Pasiphaeidae species.

